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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
MUTSCHLER, BRIAN L	

ART UNIT	PAPER NUMBER
1753	

DATE MAILED: 10/27/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/762,582	HONGO ET AL.	
	Examiner	Art Unit	
	Brian L. Mutschler	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 September 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *36,37,39 and 41-49* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *36,37,39 and 41-49* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Comments

1. Applicant's cancellation of claims 38 and 40 and addition of claim 49 in the response received on September 2, 2004, is acknowledged.

2. The rejection of claims 36-38 and 48 under 35 U.S.C. 102(e) over Hanson et al. has been overcome by Applicant's amendment to the claims. The rejections set forth below have been modified in response to the amendment.

3. The rejection of claims 36, 37, and 48 under 35 U.S.C. 102(e) over White et al. has been overcome by Applicant's amendment to the claims.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 36, 37, 41, 48, and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanson et al. (U.S. Pat. No. 6,091,498) in view of Uzoh et al. (U.S. Pat. No. 6,140,234) and in view of JP 05-331653 A ("JP '653").

Regarding claim 36, Hanson et al. disclose an apparatus for plating a surface of a substrate, wherein the apparatus comprises a frame, a load/unload unit **12**, a transfer mechanism **62, 64** and a plurality of processing units **20, 22, 24** surrounding the transfer mechanism (figs. 11, 2, 10 and 11). The apparatus also includes an electrolytic plating

unit **810** (fig. 11; col. 9, lines 8-24). Hanson et al. further teach that the apparatus is used for plating copper interconnects and that a seed layer is first deposited using one or more of several processes before electroplating (col. 1, lines 38-64). Hanson et al. provide examples of CVD or PVD as a method for forming the seed layer (col. 1, lines 47-51).

Regarding claim 37, the transfer mechanism is linearly movable along paths **68, 70** (fig. 2; col. 6, lines 12-28).

Regarding claim 41, Hanson et al. disclose that the apparatus further comprises a processing unit for pre-treating the substrate prior to electroplating (col. 9, lines 8-24).

Regarding claim 48, the frame of the apparatus is rectangular in shape (figs. 1, 2, 10, and 11).

The apparatus of Hanson et al. differs from the instant invention because Hanson et al. do not disclose the use of an electroless plating unit, which includes a plating cell for forming a hermetically sealed space with the substrate having a volume sufficient for receiving a minimum amount of an electroless plating liquid, as recited in claim 36. In addition, Hanson et al. do not disclose an electroless plating unit including a waste liquid tank for receiving used electroless plating liquid, as recited in claim 49.

Regarding the inclusion of an electroless plating unit, Uzoh et al. disclose a method for plating a semiconductor substrate comprising the steps of depositing a seed layer **6** by an electroless plating method or CVD method (col. 3, lines 66-67) followed by forming a conductive metal layer **8** by electroplating copper on the seed layer **6** using a

plating bath (col. 4, lines 25-47). Electroless plating methods require the use of a plating liquid.

Regarding the hermetically sealed space, JP '653 disclose an electroless plating unit that is hermetically sealed to control pressure within the chamber and minimize the formation of gas bubbles on the surface of the substrate (see par. [0004]-[0005]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus of Hanson et al. to use an electroless plating unit to form the seed layer as taught by Uzoh et al. because Uzoh et al. teach that electrolessly plating the seed layer is an effective means of preparing a copper seed layer prior to electroplating and that electroless plating and CVD can be used equivalently to form a seed layer.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have further modified the apparatus to use a hermetically sealed electroless plating unit as taught by JP '653 because a hermetically sealed electroless plating unit advantageously provides the ability to control bubble formation on the surface of the substrate. In addition, a hermetically sealed electroless plating unit protects the plating solution from contamination.

Regarding claim 49, JP '653 discloses an electroless plating unit comprising a waste liquid tank (liquid recovery tank **8**) that enables used plating solution to be recovered (fig. 1; par. [0008]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have further modified the electroless plating unit to include a waste liquid tank for receiving used plating solution as taught by JP '653 because the liquid recovery tank allows the plating solution to be recovered for reuse or disposal.

6. Claim 39 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hanson et al. (U.S. Pat. No. 6,091,498) in view of Uzoh et al. (U.S. Pat. No. 6,140,234) and JP 05-331653 A, as applied above to claims 36, 37, 41, 48, and 49, and further in view of Ting et al. (U.S. Pat. No. 6,017,437).

Hanson et al., Uzoh et al., and JP '653 disclose an apparatus having the limitations recited claims 36, 37, 41, 48, and 49 of the instant invention, as explained above in section 5.

Hanson et al. further teach the use of a rinsing and drying module **805** (fig. 11; col. 9, lines 8-24).

The rinsing and drying module in the apparatus described by Hanson et al., Uzoh et al., and JP '653 differs from the instant invention because they do not disclose that the module is capable of spin-drying the substrate, as recited in claim 39.

Ting et al. disclose an apparatus for electroplating a semiconductor comprising an electroplating bath and a rinsing (cleaning) and drying device capable of spinning to enhance rinsing and drying (col. 11, line 57 to col. 12, line 6).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the rinsing and drying module in the apparatus

described by Hanson et al., Uzoh et al., and JP '653 to use a cleaning and drying device capable of spinning as taught by Ting et al. because spinning enhances rinsing and drying.

7. Claims 42-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanson et al. (U.S. Pat. No. 6,091,498) in view of Uzoh et al. (U.S. Pat. No. 6,140,234) and JP 05-331653 A, as applied above to claims 36, 37, 41, 48, and 49, and further in view of either Dahms et al. (U.S. Pat. No. 5,849,171) or Dahms et al. (U.S. Pat. No. 5,433,840), herein referred to as US '171 and US '840, respectively.

Hanson et al., Uzoh et al., and JP '653 describe an apparatus having the limitations recited claims 36, 37, 41, 48, and 49 of the instant invention, as explained above in section 5.

Hanson et al. further disclose that the apparatus is used to electroplate copper on a substrate (col. 1, lines 18-24).

Regarding claims 42-47, Uzoh et al. also teach electroplating copper and further disclose that the plating solution comprises an acidic copper plating bath having sulfuric acid, copper sulfate, chloride ions and brighteners such as polyalkylene glycols (the compounds having the basic formula recited in claim 46 of the instant application) (col. 4, lines 25-64). Additionally, Uzoh et al. disclose the use of other additives, such as sulfur-containing compounds (disulfides and safranine-type dyes), and nitrogen containing compounds (col. 4, lines 48-64).

The apparatus described by Hanson et al., Uzoh et al., and JP '653 differs from the instant invention because they do not disclose the following:

a. The electroless plating bath has a concentration of copper sulfate of 100 to 250 g/L, as recited in claim 42.

b. The electroless plating bath has a concentration of sulfuric acid of 10 to 100 g/L, as recited in claim 43.

c. The electroless plating bath has a concentration of chlorine ions of 0 to 100 mg/L, as recited in claim 44.

d. The electroless plating bath has a sulfur compound expressed by the formula X-L-$(S)_n$-L-X at a concentration of at least 0.14 to 70 μmol/L, as recited in claim 45.

e. The electroless plating bath has a macromolecular compound expressed by the formula

$$R_1\text{-}(CH_2CHO)_m\text{-}(CH_2CHO)_k\text{-}H$$

(R_2 and R_3 are attached to the two CH_2CHO groups, respectively)

at a concentration of 10 to 5000 mg/L, as recited in claim 46.

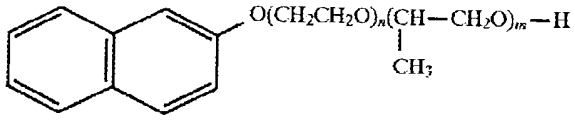
f. The electroless plating bath has a nitrogen compound at a concentration of 0.01 to 100 mg/L, as recited in claim 47.

Regarding claims 42-47, US '171 discloses a plating solution for plating copper, wherein plating bath contains a solution comprising 20-250 g/L of copper sulfate ($CuSO_4 \cdot 5H_2O$), 50-350 g/L of sulfuric acid (H_2SO_4), and 0.02-0.25 g/L of sodium chloride (NaCl), which provides chlorine ions at a concentration of 12-151 mg/L (col. 4, lines 15-28).

US '171 also discloses the use of a sulfur-containing additive, which can include bis-(w-sulfopropyl)-disulfide disodium salt, which has the chemical formula, $NaSO_3(CH_2)_3S\text{-}S(CH_2)_3SO_3Na$ (col. 4, lines 54-67). The sulfur-containing brightening agent (M.W. 354) is supplied at a concentration of 0.01 g/L, which equates to a concentration of 28 µmol/L (col. 4, line 55).

The plating solution in Example 1 of US '171 further comprises 0.02 g/L (20 mg/L) of a nitrogen-containing compound, 7-dimethylamino-5-phenyl-phenazonium chloride (col. 4, lines 57-58).

US '171 also discloses the use of polyethylene glycol and polypropylene glycol polymers and copolymers having the basic formula recited in formula [B] of the instant invention. The plating solution contains a β-naphtholalkoxylate shown by the general formula below, where n=0-50 and m=0-50:



In Example 1, US '171 teaches the use of 25 mg/L of the β-naphtholalkoxylate shown above, as well as 200 mg/L of polyethylene glycol (col. 4, line 54 to col. 5, line 4).

When the plating bath taught in US '171 is used, the plating has "a mirror finish and is well smoothed" and has no voids (col. 5, lines 1-4).

Regarding claims 42-47, US '840 discloses a plating solution and a method for using a plating solution for plating the conductors of printed circuits, wherein the plating

solution comprises 20-250 g/L of copper sulfate ($CuSO_4 \cdot 5H_2O$), 50-350 g/L of sulfuric acid (H_2SO_4), and 10 to 180 mg/L of chloride ions (col. 3, lines 68 to col. 4, line 8).

US '840 discloses the use of 7-dimethylamino-5-phenyl phenazonium chloride, which is a nitrogen-containing compound (col. 4, lines 45-46).

US '840 discloses the use of bis-(ω-sulfopropyl)disulfide, disodium salt, which has the chemical formula, $NaSO_3(CH_2)_3S\text{-}S(CH_2)_3SO_3Na$ (col. 4, lines 41-42). The sulfur-containing brightening agent (M.W. 354) is supplied at a concentration of 0.01 g/L, which equates to a concentration of 28 μmol/L (col. 4, line 41-42).

US '840 teaches the use of polyethylene glycol and polypropylene glycol in concentrations of 0.2 g/L and 0.6 g/L, respectively (col. 4, lines 40-68). Both polyethylene glycol and polypropylene glycol have chemical formulas contained in Formula [B]. The molecular weight of the polyalkylene glycols is between 500 and 35000 g/mol (col. 2, lines 2-4), which corresponds to a value of m+k of about 8 to about 800, wherein m=k because the repeating unit is the same.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the electroless plating bath described by Hanson et al., Uzoh et al., and JP '653 to use a plating bath having the composition taught by Dahms et al. in either US '171 or US '840 because both solutions have been shown to plate copper having a smooth uniform surface with no voids.

Response to Arguments

8. Applicant's arguments with respect to claims 36, 37, 39, and 41-49 have been considered but are moot in view of the new ground(s) of rejection.

9. Applicant's amendment added new limitations requiring the new grounds of rejection. Although a hermetically sealed electroless plating unit was previously claimed in cancelled claim 12, the incorporation of this limitation presented a new combination of elements that have not previously been addressed. Applicant's arguments focus on the newly added limitations, which have been addressed in the rejections set forth above (see pages 6-7 of Applicant's response).

Conclusion

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (571) 272-1341. The examiner can normally be reached on Monday-Friday from 7:30am to 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BLM
October 18, 2004

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